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Leading article

Novel method for comparing coverage by future methods of ballistic facial protection

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Abstract

The wearing of eye protection by United Kingdom soldiers in Afghanistan has reduced the morbidity caused by explosive fragments. However, the remaining face remains uncovered because there is a lack of evidence to substantiate the procurement of methods to protect it. Using a new computerised tool we entered details of the entry sites of surface wounds caused by explosive fragments in all UK soldiers who were injured in the face between 1 January 2010 and 31 December 2011. We compared clinical and predicted immediate and long term outcomes (as defined by the Abbreviated Injury Score (AIS) and the Functional Capacity Index (pFCI), respectively). We also used the tool to predict how additional protection in the form of a visor and mandible guard would affect outcomes. A soldier wearing eye protection was 9 times (1.03/0.12) less likely to sustain an eye injury than one without. However, 38% of soldiers in this series were not wearing eye protection at the time of injury. There was no significant difference between the AIS and pFCI scores predicted by the tool and those found clinically. There is limited evidence to support the use of a mandible guard; its greatest asset is better protection of the nose, but a visor would be expected to reduce long-term morbidity more than eye protection alone, and we recommend future trials to assess its acceptability to users. We think that use of this novel tool can help in the selection of future methods of ballistic facial protection.

Keywords: Ballistic; Face; Eye; Protection; Injury; Outcome; Prediction; Wound; Mapping

Introduction

Most injuries sustained by United Kingdom soldiers currently deployed to Afghanistan are caused by explosively propelled fragments.[1] Although the introduction of personal protective equipment (body armour and general service combat helmets) has dramatically reduced the number of cranial and thoracoabdominal wounds in UK forces, the relative incidence of injuries to the face and eyes in relation to all areas of the body has, until recently, changed little from that of World War One.[2–4]

Currently, protective equipment that covers the face and eyes includes the Mark 7 combat helmet, low impact ballistic spectacles, and medium impact ballistic goggles (Fig. 1).[5] Combat helmets and eye protection are widely recognised to protect against explosive fragments but to our knowledge this has never been shown objectively.[4,6,7] Between 1 Jan 2005 and 31 Dec 2009, it was thought that UK service personnel wearing eye protection were 10 times less likely to be injured in the eye,[4] but the findings were limited, as in many cases it was not known whether protection had been worn at the time of injury. Previous research has suggested that greater coverage of the face could reduce morbidity,[4,5] and a recent review showed that the 2 main methods of facial protection that can

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Fig. 1. Personal protective equipment issued to UK soldiers that covers the face or eyes: low impact ballistic spectacles (top); medium impact ballistic goggles (middle); Mark 7 combat helmet (bottom).

be worn in addition to eye protection broadly encompass visors and mandible guards (Fig. 2).[2,8] However, currently we know of no objective evidence for their potential efficacy in reducing morbidity.

Information on the types of injuries sustained by UK service personnel on operations is contained in the UK Joint Theatre Trauma Registry held by the Royal Centre for Defence Medicine.[4] Information is currently entered retrospectively using clinical records for survivors and post mortem records for fatalities.[4,9] For epidemiological purposes, each injury is also given a numerical value from the Abbreviated Injury Scale (AIS), which ranges from 1 (minor) to 6 (maximal, currently untreatable); these scores are excellent predictors of injuries that cause an immediate or early threat to life.[2,10,11] The use of this scale has become a powerful epidemiological tool for the Ministry of Defence, as it not only validates the types of treatment given to UK service personnel,[2] but informs far-reaching decisions such as the design of future military vehicles.[1] However, it was not designed to predict residual impairment, functional limitations, or poor aesthetics,[11,12] factors that have been shown to define the outcome of military injuries to the face and eyes.[4] In the latest (2008) revision of the AIS 2005 handbook,[11] additional predicted Functional Capacity Index (pFCI) scores have now been included in an attempt to reflect the functional limitations of a person after one year.[11,12]

Fig. 2. Commercial examples of a mandible guard (left) and visor (right). Permission to reproduce granted by Revision Military®, Essex Junction, USA.

The mapping of surface wounds is the process by which the sites where projectiles have perforated the skin are recorded graphically.[4,9] It has been attempted intermittently since World War One,[13,14] but has never gained mainstream acceptance despite the potential for the validation of coverage provided by different designs of protective equipment.[4,9] The Defence Science and Technology Laboratory based at Porton Down has developed a new electronic mapping program for surface wounds designated IMAP (Interactive Mapping Analysis Platform),[9] which is designed to be used in conjunction with the Joint Theatre Trauma Registry. IMAP, which has been designed using the dimensions of an anthropometrically representative 50th percentile UK male soldier,[5] allows the geometries of any type of protective equipment to be imported. Currently, the site of each wound entered is linked to immediate and early outcomes using AIS scores,[9] but the use of pFCI scores could potentially enable the site to be related to long-term morbidity.

We aimed to measure the utility of this wound mapping tool to compare immediate and longer term outcomes of injuries to the face and eyes from explosively propelled fragments. This would in turn provide evidence to justify the need for additional forms of body armour to protect the remaining face.

Method

We used the Joint Theatre Trauma Registry to identify all UK service personnel in Afghanistan who had been injured in the face or eyes by explosively propelled fragments between 01 January 2010 and 31 December 2011; this included survivors, those killed in action, and those who died of wounds. Using a combination of the registry, post mortem records, and seeing the patient in person, we found out whether ballistic spectacles, goggles, and a helmet had been worn at the time of